Lifestyle and health-related predictors of cervical cancer screening attendance in a Swiss population-based study

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Abstract: BACKGROUND: Since the implementation of cervical cancer (CC) screening, incidence and mortality rates have decreased worldwide. Little is known about lifestyle and health-related predictors of cervical cancer screening attendance in Switzerland. Our aim was to examine the relationship between lifestyle and health-related factors and the attendance to CC screening in Switzerland. METHODS: We analyzed data of 20-69 years old women (n=7319) of the Swiss Health Survey (SHS) 2012. Lifestyle factors included body mass index, smoking status, alcohol consumption, physical activity and attention to diet. Health-related factors of interest were diabetes, hypertension, high cholesterol levels, chronic diseases, self-perceived health, and psychological distress. We performed multivariable logistic regression analyses with the dichotomized CC screening status as outcome measure and adjusted for demographic factors. RESULTS: Obesity, low physical activity, and not paying attention to diet were statistically significantly associated with lower CC screening participation. High cholesterol levels and history of chronic diseases were statistically significantly positively associated with screening participation. CONCLUSION: Being obese, physically inactive and non-attention to diet are risk factors for CC screening attendance. These findings are of importance for improving the CC screening practices of low-user groups.

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Abstract

Background: Since the implementation of cervical cancer (CC) screening, incidence and mortality rates have decreased worldwide. Little is known about lifestyle and health-related predictors of cervical cancer screening attendance in Switzerland. Our aim was to examine the relationship between lifestyle and health-related factors and the attendance to CC screening in Switzerland.

Methods: We analyzed data of 20-69 years old women (n=7,319) of the Swiss Health Survey (SHS) 2012. Lifestyle factors included body mass index, smoking status, alcohol consumption, physical activity and attention to diet. Health-related factors of interest were diabetes, hypertension, high cholesterol levels, chronic diseases, self-perceived health, and psychological distress.

We performed multivariable logistic regression analyses with the dichotomized CC screening status as outcome measure and adjusted for demographic factors.

Results: Obesity, low physical activity, and not paying attention to diet were statistically significantly associated with lower CC screening participation. High cholesterol levels and history of chronic diseases were statistically significantly positively associated with screening participation.

Conclusion: Being obese, physically inactive and non-attention to diet are risk factors for CC screening attendance. These findings are of importance for improving the CC screening practices of low-user groups.

Keywords: Cervical cancer, screening, lifestyle, health, Switzerland

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Introduction

Cervical cancer (CC) is the second most common cancer in women worldwide, although incidence and mortality have decreased markedly (Ferlay et al., 2013; National Institue for Cancer Epidemiology and Registration, 2011), following the introduction of the Papanicolaou (PAP) test for cervical cancer. It is estimated that CC screening reduces cervical cancer incidence by approximately 80% (Arbyn et al., 2009; IARC, 2005). In Switzerland, which provides a broad, opportunistic screening system, CC screening has been promoted since the late 1960s. This resulted in a reduced CC incidence, from 440 new cases in 1980 to 210 cases in 2007 (National Institue for Cancer Epidemiology and Registration, 2011). Recommendations of the Swiss Federal law of health insurance for CC screening in Switzerland include one Pap smear every three years after two annual negative results from the age of 18 until 69 years (Arbeitsgruppe "Guideline, 2005). In general, women are invited by their gynecologist for the examination. The CC screening time interval depends on the doctor's personal judgment. For CC screening there is no organized program in Switzerland.

So far, it has been shown convincingly that demographic factors are of importance in relation to CC screening attendance. Accordingly, a systematic review found a positive association of educational level and financial status with CC screening attendance (Limmer et al., 2014). Furthermore, being married was associated with higher attendance in different ethnicities. In contrast, age appears to be inversely associated to CC screening. Another review observed a lower participation rate in screening in older, uninsured, homeless and migrant women with language barriers, in women who have sex with women, and in obese women (Brankovic et al., 2013). According to the 2007 Swiss Health Survey, women with Swiss nationality and high educational level adhered more often to CC screening than non-Swiss women and women with only compulsory education (Oncosuisse, 2011).

Only few studies examined the associations of lifestyle and health factors with CC screening attendance. Nelson et al. reported that smokers, obese women and women with psychological distress participated less often in CC screening (Nelson et al., 2009). Obesity was shown to be a predictor of lower CC screening attendance in a variety of studies; nonetheless, opposite or null results between obesity and screening participation were observed in some other studies (Aldrich and Hackley, 2010; Cohen et al., 2008). A systematic review came to the conclusion that perceived screening facilities-related barriers and perceived psychological barriers to CC screening were associated with lower screening participation (Bukowska-Durawa and Luszczynska, 2014).

Chronic diseases, such as diabetes or hypertension were negatively associated with CC screening attendance (Kiefe et al., 1998; Liu et al., 2014; Tabaei et al., 2005) in some but not all studies (Lopez-de-Andres et al., 2010). Regarding associations between mental health and CC screening attendance, a lower screening participation among women with mental health problems such as depression or psychological distress was observed (Ludman et al., 2010; Xiang, 2015).

To our knowledge, there is no information about associations of lifestyle factors and health-related factors with CC screening attendance in Switzerland. Thus, we assessed lifestyle factors (body mass index [BMI], smoking status, alcohol consumption, physical activity, attention to diet and health-related factors (diabetes, hypertension, cholesterol, self-perceived health, psychological distress, and chronic disease) that may affect CC screening participation.

Methods

Study population and design

We used data of the cross-sectional 2012 Swiss Health Survey (SHS), which is conducted every five years since 1992 by the Swiss Federal Office of Statistics (SFSO) (Legal basis: Ordinance of the Conduct of Federal Statistical Surveys of 30 June 1993). This population-based survey provides information on health status, several lifestyle and demographic factors and the utilization of health services. A total number of 41,008 participants were randomly selected by a sampling technique based on registries of inhabitants including Swiss and foreigners with a work permit aged 15 years and older and living in a private household. A computer-assisted telephone interview (CATI) was performed and German-, French-, or Italian-speaking individuals were included. The participation rate was 54% amounting to 21,597 individuals. Weighting factors were then used to improve the level of representation of the sample for the Swiss population.

A total of 11,314 women participated in the SHS 2012. After including only women aged 20-69 years (n=8,816) with available information on CC screening participation, our sample consisted of 7,556 women. After excluding women with missing information on demographic factors (n=28), lifestyle factors (n=96) and diseases (n=113), our final sample consisted of 7,319 women.

Measurements

Variables of interest: As lifestyle factors we included BMI categorized into underweight (BMI <18.5 kg/m^2), normal weight (BMI 18.5-24.9 kg/m^2), overweight (BMI 25.0-29.9 kg/m^2) and obesity (BMI ≥ 30 kg/m^2) (National Institutes of Health, 1998), smoking status (never, former, current), chronic

alcohol consumption associated with health risk (≥20 gram ethanol daily vs. less) (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2010), physical activity (≥ 150 minutes per week moderate physical activity and/or one sweating episode per week vs. less) (Bundesamt für Sport BASPO et al., 2013), and paying attention to diet (yes vs. no). As health-related factors we included self-reported chronic conditions such as diabetes, hypertension, high cholesterol levels (assessed by the question: "Have you ever been told by a medical doctor that you were affected by…") and chronic diseases (ongoing diseases or health problems lasting for at least six months or expected to last a further six months). In addition, self-perceived health status (fair, poor, very poor vs. very good, good) was examined. For the assessment of psychological distress (low, moderate, high) during the previous four weeks, the 5-item mental health index [MHI-5] was used (Berwick et al., 1991).

Outcome Variable: CC screening status was calculated based on the date of the interview and the self-reported information of the date of the last CC screening and then dichotomized in ≤3 years since most recent screening vs. >3 years or never.

Covariates: Demographic variables were used as adjustment factors based on the known associations regarding CC screening participation. Demographics included age, region of Switzerland (German vs. French vs. Italian), area of residence (urban vs. rural), nationality (Swiss vs. non-Swiss), educational level (low [compulsory education or less] vs. middle [secondary education] vs. high [tertiary education]), and marital status (married, registered partnership vs. single, divorced, dissolved, separated, widowed).

Statistical analyses

All statistical analyses were conducted using STATA software version 13.1 (College Station, Texas). Descriptive statistics were computed in percentages for socio-demographic, lifestyle and health-related factors. We conducted logistic regression analyses to determine the association of each single lifestyle and health-related factor with CC screening participation. We provided unadjusted results and results adjusted for demographic factors (age, region of Switzerland, area of residence, nationality, educational level, and marital status as odds ratios (OR) with the corresponding 95% confidence intervals (95% CI). Furthermore, to account for a possible non-response bias, we performed a sensitivity analysis with the women aged 20-69 years, who were not included in the analyses because of missing or unclear information on screening status.

Sampling weights of the telephone interviews were provided by the SFSO and applied to the data of the present analyses to calculate descriptive characteristics (percentages) and to conduct logistic

regression analyses. The sampling weights include a comparison with the permanent 2012 Swiss population with regard to sex, age, geographic region and nationality (Swiss vs. others).

Results

Table 1 shows the distribution of demographic, lifestyle, and health-related factors of the study sample (n=7,319). Participation rate for CC screening within the last three years was 72.9% compared to 9.3% of the women who had participated more than 3 years ago, and 17.8% of the women who had never attended screening.

More than two-thirds of the women lived in the German-speaking region, less than one third lived in the French-speaking region, and the remaining 5.1% in the Italian-speaking region. Overall, living in urban areas was reported by 73.1%. Most of the participants were Swiss and had a middle educational level. Living in a partnership (married or registered partnership) was more frequently reported than being single, divorced/dissolved, separated or widowed (54.3% vs. 45.7%, respectively).

At least half of the included women reported a normal BMI (18.5–24.9 kg/m^2), no history of smoking, low chronic alcohol consumption, regular physical activity, and paid attention to their diet.

Diabetes was observed in 2.6% of women, hypertension in 18.8%, and high cholesterol levels in 12.9%. More than two-thirds of the women reported a history of chronic diseases, but the majority considered their self-perceived health as good and their psychological distress as low.

A sensitivity analysis revealed that the mean age of women excluded from our analyses differed with respect to the mean age compared to our sample (45.3 vs. 40.9 year). In contrast, more included women were of Swiss nationality (77.5% vs. 69.2%), had a high (27.2% vs. 22.5%) or middle (61.2% vs. 53.5%) educational level, and were more often not in a partnership (45.7% vs. 37.1%) compared to the non-included women.

Table 2 shows the association of lifestyle and health-related factors with CC screening participation within the previous three years versus more than three years or never. Overweight and obese women had statistically significantly lower odds of attendance in CC screening than normal weight women in the unadjusted model. After adjustment for demographic factors, the results were attenuated for overweight but remained statistically significant for obese women (OR 0.64, 95% CI 0.51-0.81). Ex-smokers adhered to CC screening statistically significantly more often than women who had never smoked (reference) (OR 1.37, 95% CI 1.14-1.65; multivariable adjustment). Women

who were physically active for less than 150 minutes per week had statistically significantly lower odds for CC screening participation compared to the more physically active women (OR 0.85, 95% CI 0.74-0.99; multivariable adjustment). We observed a statistically significantly lower odd of CC screening attendance (OR 0.82, 95% CI 0.69-0.96, multivariable adjustment) in women who reported not paying close attention to their diet.

Neither diabetes nor hypertension was associated with CC screening attendance. Women with high cholesterol levels were more likely to participate in CC screening than women with normal cholesterol levels. The OR was statistically significant in the multivariable model (OR 1.45, 95% CI 1.19-1.77). Regarding health-related factors, chronic diseases were statistically significantly associated with higher odds of CC screening attendance in the unadjusted and multivariable adjusted model (OR 1.19, 95% CI 1.03-1.37 and OR 1.28, 95% CI 1.11-1.48, respectively). Self-perceived health and psychological distress were not associated with CC screening participation.

Discussion

In the present study, among lifestyle factors, individuals participated significantly less in CC screening if they reported being obese, not having regular physical activity, or not paying attention to diet. Prior smoking, on the other hand, was associated with higher attendance than non-smoking. Concerning health-related factors, having high cholesterol levels and/or chronic diseases were positively associated with screening participation. All results were adjusted for various socio-demographic factors.

The participation rate in CC screening of the 20-69 year-old women living in Switzerland within the last three years (72.9%) lies within the range of other European countries. Participation rates vary depending on type of screening program (opportunistic or organized) and local CC screening recommendations. Participation rates amounted to 61% in Belgium (Arbyn et al., 2014), 86.6% in Norway (Hansen et al., 2011), between 78.5% and 83.5% in England (Bang et al., 2012), and 70% in Austria (Breitenecker, 2009).

A persistent human papillomavirus (HPV) infection is necessary but may not be sufficient alone for the development of cervical cancer. Thus, whether a woman will develop cervical cancer seems to depend on a number of additional factors (Burd, 2003). Accordingly, several, but not all studies have shown that obesity is associated with increased risk for cervical cancer, particularly adenocarcinoma (Lacey et al., 2003; Tornberg and Carstensen, 1994; Webb, 2013). There is also limited evidence that obesity is associated with cervical cancer mortality (Calle et al., 2003; Lee et al., 2013). In this

context, it is of importance to note that obese women, as in the present study, may be screened less frequently for CC than women of normal weight (Bussiere et al., 2014; Fontaine et al., 2001; Maruthur et al., 2009; Ostbye et al., 2005; Wee et al., 2000), even though the evidence is not entirely consistent (Kim et al., 2009; Reidpath et al., 2002). As Maruthur et al. (2009) pointed out, there are several potential barriers to CC screening participation for overweight and obese women. Apart from equipment-related impediments, the fear of discomfort and pain from the medical examination, being embarrassed or afraid of undergoing testing, unwanted criticisms due to excess weight, uninvited advice to reduce body weight, and lack of respect from medical doctors may play a role (Bussiere et al., 2014; Maruthur et al., 2009).

As in the present study, several other surveys found unhealthy behaviors such as low levels of physical activity (Abdullah and Leung, 2001; Coughlin et al., 2004; Muus et al., 2012; Ostbye et al., 2005), cigarette smoking (Byrne et al., 2010; Vander Weg et al., 2012), hazardous alcohol consumption (Sicsic and Franc, 2014) and low fruit and vegetable consumption/unbalanced diet (Abdullah and Leung, 2001) to be associated with lower rates of CC screening participation. It should be noted that only one (Coughlin et al., 1999) of these studies adjusted for body weight. Women with unhealthy behaviors may be less health conscious than individuals with healthy habits, and thus, less likely to adhere to regular cancer screening (Muus et al., 2012). Accordingly, Galan et al. (2006) observed in their cross-sectional study in Spain that the clustering of behavioral risk factors (tobacco smoking, hazardous alcohol consumption, leisure-time sedentariness and unbalanced dietary habits) was associated with greater non-attendance to the recommended CC screening. Similarly, in a cross-sectional analysis of the US 2000 National Health Interview data, a healthier lifestyle including non-smoking, physical activity, high fruit and vegetable and low alcohol consumption was significantly positively associated with CC screening use (Meissner et al., 2009). However, the association between smoking and CC screening attendance seems to be multifaceted. Vander Weg et al. observed in their cross-sectional analysis of data from the U.S. 2008 Behavioral Risk Factor Surveillance System that former smokers had a higher compliance with CC screening attendance than daily smokers and women who had never smoked (Vander Weg et al., 2012). The authors hypothesized that former smokers who are more health conscious may be more likely to both stop smoking and to participate in CC screening. We observed similar results in the present study and hypothesize that the higher compliance of former smokers with CC screening might also be the consequence of an increased risk of smokers for cervical dysplasia with the corresponding necessity for regular screening.

Another determinant of CC screening attendance may be an individual's health status (Schumacher et al., 2008). In the present study, reported chronic diseases (ongoing disease or health problem

lasting for at least six months or expected to last a further six months) were associated with higher odds of CC screening attendance compared to no chronic diseases. Furthermore, in a cross-sectional Spanish study, CC screening attendance was positively associated with osteomuscular disease (Lopez-de-Andres et al., 2010). The authors argued that the presence of medical conditions might increase the opportunity of receiving cancer screening because of more frequent contact with healthcare providers.

Other studies found inverse associations between history of chronic diseases and CC screening attendance (Kiefe et al., 1998; Liu et al., 2014; Tabaei et al., 2005). Additionally, a recent visit to a primary care provider or having had a recent routine check-up was a predictor of CC screening in some studies (de Quadros et al., 2004; Martins et al., 2009; Nascimento et al., 1996).

High blood cholesterol levels were positively associated with CC screening participation. We hypothesize that high cholesterol levels represents a poor health status, which is normally associated with a visit to a physician. On the other hand, it might also reflect the fact that those women, who had had other screening tests (e.g. BC screening, cholesterol check), are more likely to attend CC screening in addition (Borrayo et al., 2004; Carruth et al., 2006; Martins et al., 2009).

Mental health, on the other hand, was not related to CC screening participation in the present study. Previous surveys examining this association have found varying results (Xiang, 2015). Accordingly, a systematic review by Aggarwal et al.(2013) included 15 studies that examined breast and CC screening attendance among women with mental diseases such as depression, anxiety, schizophrenia and psychosis. In seven of these studies, mental illness was associated with lower cancer screening attendance.

Some of the discussed factors may also impair attendance to screening other than CC screening (Gimeno Garcia, 2012; Lagerlund et al., 2015). Obese individuals, for example, might be less likely than non-obese persons to be screened for colorectal and breast cancer (Eichholzer et al., 2015; Ferrante et al., 2006) even though the evidence is not consistent.

The current study has several positive features including the large, nationally representative sample of individuals 20-69 years living in Switzerland and the comprehensiveness of its data allowing for adjustment for a number of important covariates associated with lifestyle/health-related factors and CC screening attendance. Nevertheless, it is a cross-sectional survey, thus causal and directional conclusions are precluded. The fact that receipt of CC screening and studied lifestyle and health factors were based solely on self-report and were not physician-confirmed is another limitation. Self-reported screening behaviors from national surveys often overestimate screening use (Howard et al., 2009). In addition, body height and weight, were also not clinically assessed. Previous studies have

shown that weight is often under-reported, especially in overweight females, leading to an underestimation of BMI (Faeh et al., 2008). Moreover, due to the low overall response rate of 54% in the SHS, the possibility of response bias cannot be ruled out. The use of weighting factors, nevertheless, allows for the extrapolation of the results in relation to age, sex, region and nationality from the sample to the total population living in Switzerland (SFSO). In addition, even though we controlled for educational level as a proxy for socio-economic factors that may be associated with both CC screening participation and lifestyle and health factors, residual confounding cannot be excluded, such as that financial status is known to affects the CC participation rate.

Furthermore, women with valid information on CC screening status differed in respect to demographic factors from the non-included women, which had missing or unclear information on CC screening participation. Thus, although we controlled for demographic factors, there may be a response bias, such as that screening status was more often reported in women with high educational level. Finally, factors that may be significant determinants of CC screening attendance such as knowledge and beliefs about the benefits of CC screening, were not recorded in the current study (Klug et al., 2005; Lo et al., 2013).

In conclusion, being overweight or obese, physically inactive and not paying attention to diet are risk factors for non-attendance to CC screening. Being affected by chronic diseases and high cholesterol levels on the other hand, were associated with higher odds of CC screening attendance in Switzerland. These findings are of importance for improving the CC screening practices of the low user groups in Switzerland.

Conflict of Interest statement

The authors declare that there are no conflicts of interest.

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References

Abdullah, A.S., Leung, T.Y., 2001. Factors associated with the use of breast and cervical cancer screening services among Chinese women in Hong Kong. Public Health 115:212-7.
Aggarwal, A., Pandurangi, A., Smith, W., 2013. Disparities in breast and cervical cancer screening in women with mental illness: a systematic literature review. Am J Prev Med 44:392-8.
Aldrich, T., Hackley, B., 2010. The impact of obesity on gynecologic cancer screening: an integrative literature review. Journal of midwifery & women's health 55:344-56.
Arbeitsgruppe "Guideline, Z., 2005. [Guideline for managing suspect and positive cytologic smears of the uterine cervix (revised form, version 2.4)]. Gynakol Geburtshilfliche Rundsch 45:44-55.
Arbyn, M., Fabri, V., Temmerman, M., Simoens, C., 2014. Attendance at cervical cancer screening and use of diagnostic and therapeutic procedures on the uterine cervix assessed from individual health insurance data (Belgium, 2002-2006). PLoS One 9:e92615.
Arbyn, M., Rebolj, M., De Kok, I.M., Fender, M., Becker, N., O'Reilly, M., Andrae, B., 2009. The challenges of organising cervical screening programmes in the 15 old member states of the European Union. Eur J Cancer 45:2671-8.
Bang, J.Y., Yadegarfar, G., Soljak, M., Majeed, A., 2012. Primary care factors associated with cervical screening coverage in England. Journal of public health 34:532-8.
Berwick, D.M., Murphy, J.M., Goldman, P.A., Ware, J.E., Jr., Barsky, A.J., Weinstein, M.C., 1991. Performance of a five-item mental health screening test. Med Care 29:169-76.
Borrayo, E.A., Thomas, J.J., Lawsin, C., 2004. Cervical cancer screening among Latinas: the importance of referral and participation in parallel cancer screening behaviors. Women & health 39:13-29.
Brankovic, I., Verdonk, P., Klinge, I., 2013. Applying a gender lens on human papillomavirus infection: cervical cancer screening, HPV DNA testing, and HPV vaccination. International journal for equity in health 12:14.
Breitenecker, G., 2009. [Cervical cancer screening: past--present--future]. Der Pathologe 30 Suppl 2:128-35.
Bukowska-Durawa, A., Luszczynska, A., 2014. Cervical cancer screening and psychosocial barriers perceived by patients. A systematic review. Contemporary oncology 18:153-9.
Bundesamt für Sport BASPO, B.f.G.B., Gesundheitsförderung, Schweiz, b.B.f.U., Suva, Netzwerk, Schweiz., G.u.B., 2013. Gesundheitswirksame Bewegung. Magglingen: BASPO.
Burd, E.M., 2003. Human papillomavirus and cervical cancer. Clin Microbiol Rev 16:1-17.
Bussiere, C., Sicsic, J., Pelletier-Fleury, N., 2014. The effects of obesity and mobility disability in access to breast and cervical cancer screening in france: results from the national health and disability survey. PLoS One 9:e104901.
Byrne, M.M., Davila, E.P., Zhao, W., Parker, D., Hooper, M.W., Caban-Martinez, A., Dietz, N., Huang, Y., Messiah, A., et al., 2010. Cancer screening behaviors among smokers and non-smokers. Cancer Epidemiol 34:611-7.
Calle, E.E., Rodriguez, C., Walker-Thurmond, K., Thun, M.J., 2003. Overweight, obesity, and mortality from cancer in a prospectively studied cohort of U.S. adults. N Engl J Med 348:1625-38.
Carruth, A.K., Browning, S., Reed, D.B., Skarke, L., Sealey, L., 2006. The impact of farm lifestyle and health characteristics: cervical cancer screening among southern farmwomen. Nurs Res 55:121-7.
Cohen, S.S., Palmieri, R.T., Nyante, S.J., Koralek, D.O., Kim, S., Bradshaw, P., Olshan, A.F., 2008. Obesity and screening for breast, cervical, and colorectal cancer in women: a review. Cancer 112:1892-904.
Coughlin, S.S., Uhler, R.J., Blackman, D.K., 1999. Breast and cervical cancer screening practices among American Indian and Alaska Native women in the United States, 1992-1997. Preventive medicine 29:287-95.
Coughlin, S.S., Uhler, R.J., Hall, H.I., Briss, P.A., 2004. Nonadherence to breast and cervical cancer screening: what are the linkages to chronic disease risk? Preventing chronic disease 1:A04.

de Quadros, C.A., Victora, C.G., da Costa, J.S., 2004. Coverage and focus of a cervical cancer prevention program in southern Brazil. Revista panamericana de salud publica = Pan American journal of public health 16:223-32.
Eichholzer, M., Richard, A., Rohrmann, S., Schmid, S., Guth, U., 2015. Overweight, obesity, and breast cancer screening: results from the 2012 Swiss Health Survey. Eur J Cancer Prev. 2015 Mar 19. [Epub ahead of print].
Faeh, D., Marques-Vidal, P., Chiolero, A., Bopp, M., 2008. Obesity in Switzerland: do estimates depend on how body mass index has been assessed? Swiss Med Wkly 138:204-10.
Ferlay, J., Steliarova-Foucher, E., Lortet-Tieulent, J., Rosso, S., Coebergh, J.W., Comber, H., Forman, D., Bray, F., 2013. Cancer incidence and mortality patterns in Europe: Estimates for 40 countries in 2012. Eur J Cancer 49:1374-403.
Ferrante, J.M., Ohman-Strickland, P., Hudson, S.V., Hahn, K.A., Scott, J.G., Crabtree, B.F., 2006. Colorectal cancer screening among obese versus non-obese patients in primary care practices. Cancer Detect Prev 30:459-65.
Fontaine, K.R., Heo, M., Allison, D.B., 2001. Body weight and cancer screening among women. Journal of women's health & gender-based medicine 10:463-70.
Galan, I., Rodriguez-Artalejo, F., Diez-Ganan, L., Tobias, A., Zorrilla, B., Gandarillas, A., 2006. Clustering of behavioural risk factors and compliance with clinical preventive recommendations in Spain. Preventive medicine 42:343-7.
Gimeno Garcia, A.Z., 2012. Factors influencing colorectal cancer screening participation. Gastroenterol Res Pract 2012:483417.
Hansen, B.T., Hukkelberg, S.S., Haldorsen, T., Eriksen, T., Skare, G.B., Nygard, M., 2011. Factors associated with non-attendance, opportunistic attendance and reminded attendance to cervical screening in an organized screening program: a cross-sectional study of 12,058 Norwegian women. BMC Public Health 11:264.
Howard, M., Agarwal, G., Lytwyn, A., 2009. Accuracy of self-reports of Pap and mammography screening compared to medical record: a meta-analysis. Cancer Causes Control 20:1-13.
IARC, 2005. Cervix Cancer Screening. IARC handbooks of cancer prevention, vol. 10. IARC Press, Lyon.
Kiefe, C.I., Funkhouser, E., Fouad, M.N., May, D.S., 1998. Chronic disease as a barrier to breast and cervical cancer screening. J Gen Intern Med 13:357-65.
Kim, B.H., Koh, S.B., Hur, H.K., Park, J.K., Park, S.M., 2009. [Women's cancer screening according to Body Mass Index in a cohort of rural Korean women]. J Korean Acad Nurs 39:641-50.
Klug, S.J., Hetzer, M., Blettner, M., 2005. Screening for breast and cervical cancer in a large German city: participation, motivation and knowledge of risk factors. European journal of public health 15:70-7.
Lacey, J.V., Jr., Swanson, C.A., Brinton, L.A., Altekruse, S.F., Barnes, W.A., Gravitt, P.E., Greenberg, M.D., Hadjimichael, O.C., McGowan, L., et al., 2003. Obesity as a potential risk factor for adenocarcinomas and squamous cell carcinomas of the uterine cervix. Cancer 98:814-21.
Lagerlund, M., Drake, I., Wirfalt, E., Sontrop, J.M., Zackrisson, S., 2015. Health-related lifestyle factors and mammography screening attendance in a Swedish cohort study. Eur J Cancer Prev 24:44-50.
Lee, J.K., So, K.A., Piyathilake, C.J., Kim, M.K., 2013. Mild obesity, physical activity, calorie intake, and the risks of cervical intraepithelial neoplasia and cervical cancer. PLoS One 8:e66555.
Limmer, K., LoBiondo-Wood, G., Dains, J., 2014. Predictors of cervical cancer screening adherence in the United States: a systematic review. Journal of the advanced practitioner in oncology 5:31-41.
Liu, B.Y., O'Malley, J., Mori, M., Fagnan, L.J., Lieberman, D., Morris, C.D., Buckley, D.I., Heintzman, J.D., Carney, P.A., 2014. The association of type and number of chronic diseases with breast, cervical, and colorectal cancer screening. Journal of the American Board of Family Medicine : JABFM 27:669-81.
Lo, S.H., Waller, J., Wardle, J., von Wagner, C., 2013. Comparing barriers to colorectal cancer screening with barriers to breast and cervical screening: a population-based survey of screening-age women in Great Britain. Journal of medical screening 20:73-9.

Lopez-de-Andres, A., Martin-Lopez, R., Hernandez-Barrera, V., Carrasco-Garrido, P., Gil-de-Miguel, A., Esteban y Pena, M.M., Jimenez-Garcia, R., 2010. Predictors of breast and cervical cancer screening in a Spanish metropolitan area. Journal of women's health 19:1675-81.
Ludman, E.J., Ichikawa, L.E., Simon, G.E., Rohde, P., Arterburn, D., Operskalski, B.H., Linde, J.A., Jeffery, R.W., 2010. Breast and cervical cancer screening specific effects of depression and obesity. Am J Prev Med 38:303-10.
Martins, L.F., Valente, J.G., Thuler, L.C., 2009. Factors related to inadequate cervical cancer screening in two Brazilian state capitals. Revista de saude publica 43:318-25.
Maruthur, N.M., Bolen, S.D., Brancati, F.L., Clark, J.M., 2009. The association of obesity and cervical cancer screening: a systematic review and meta-analysis. Obesity 17:375-81.
Meissner, H.I., Yabroff, K.R., Dodd, K.W., Leader, A.E., Ballard-Barbash, R., Berrigan, D., 2009. Are patterns of health behavior associated with cancer screening? Am J Health Promot 23:168-75.
Muus, K.J., Baker-Demaray, T.B., Bogart, T.A., Duncan, G.E., Jacobsen, C., Buchwald, D.S., Henderson, J.A., 2012. Physical activity and cervical cancer testing among American Indian women. The Journal of rural health : official journal of the American Rural Health Association and the National Rural Health Care Association 28:320-6.
Nascimento, C.M., Eluf-Neto, J., Rego, R.A., 1996. Pap test coverage in Sao Paulo municipality and characteristics of the women tested. Bulletin of the Pan American Health Organization 30:302-12.
National Institue for Cancer Epidemiology and Registration, 2011. Cancer in Switzerland - Situation and development from 1983-2007. Federal Statistical Office FSO, Neuchâtel.
National Institutes of Health, 1998. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults - the evidence report. Obes Res, pp. 51S–209S.
Nelson, W., Moser, R.P., Gaffey, A., Waldron, W., 2009. Adherence to cervical cancer screening guidelines for U.S. women aged 25-64: data from the 2005 Health Information National Trends Survey (HINTS). Journal of women's health 18:1759-68.
Oncosuisse, 2011. Nationales Krebsprogramm für die Schweiz. 2011-2015, Bern.
Ostbye, T., Taylor, D.H., Jr., Yancy, W.S., Jr., Krause, K.M., 2005. Associations between obesity and receipt of screening mammography, Papanicolaou tests, and influenza vaccination: results from the Health and Retirement Study (HRS) and the Asset and Health Dynamics Among the Oldest Old (AHEAD) Study. American journal of public health 95:1623-30.
Reidpath, D.D., Crawford, D., Tilgner, L., Gibbons, C., 2002. Relationship between body mass index and the use of healthcare services in Australia. Obes Res 10:526-31.
Schumacher, M.C., Slattery, M.L., Lanier, A.P., Ma, K.N., Edwards, S., Ferucci, E.D., Tom-Orme, L., 2008. Prevalence and predictors of cancer screening among American Indian and Alaska native people: the EARTH study. Cancer Causes Control 19:725-37.
SFSO, Swiss Federal Office of Statistics. www.sgb12.bfs.admin.ch/.
Sicsic, J., Franc, C., 2014. Obstacles to the uptake of breast, cervical, and colorectal cancer screenings: what remains to be achieved by French national programmes? BMC Health Serv Res 14:465.
Tabaei, B.P., Herman, W.H., Jabarin, A.F., Kim, C., 2005. Does diabetes care compete with the provision of women's preventive care services? Diabetes care 28:2644-9.
Tornberg, S.A., Carstensen, J.M., 1994. Relationship between Quetelet's index and cancer of breast and female genital tract in 47,000 women followed for 25 years. Br J Cancer 69:358-61.
U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2010. Dietary guidelines for Americans., 7 ed. U.S. Government Printing Office, Washington, DC.
Vander Weg, M.W., Howren, M.B., Cai, X., 2012. Use of routine clinical preventive services among daily smokers, non-daily smokers, former smokers, and never-smokers. Nicotine & tobacco research : official journal of the Society for Research on Nicotine and Tobacco 14:123-30.
Webb, P.M., 2013. Obesity and gynecologic cancer etiology and survival. American Society of Clinical Oncology educational book / ASCO. American Society of Clinical Oncology. Meeting.
Wee, C.C., McCarthy, E.P., Davis, R.B., Phillips, R.S., 2000. Screening for cervical and breast cancer: is obesity an unrecognized barrier to preventive care? Ann Intern Med 132:697-704.

Xiang, X., 2015. Serious psychological distress as a barrier to cancer screening among women. Women's health issues : official publication of the Jacobs Institute of Women's Health 25:49-55.

Tab. 1: Baseline characteristics (demographic, lifestyle and health related factors) of 18-69 years old women of the 2012 Swiss Health Survey[1]

		Total
Women, n		7319
Age, mean		43.9
		%
Cervical cancer screening	Never	17.8
	Within the last 3 years	72.9
	More than 3 years ago	9.3
Demographic factors		
Age (years)	≥ 20 to < 30	19.5
	≥ 30 to < 40	20.3
	≥ 40 to < 50	25.7
	≥ 50 to < 60	18.9
	≥ 60 to <70	15.5
Region of Switzerland	German region	68.7
	French region	26.2
	Italian region	5.1
Area of residence	Urban	73.1
	Rural	26.9
Nationality	Swiss	77.5
	Non-Swiss	22.5
Educational level	High	27.2
	Middle	61.2
	Low	11.6
Marital status	married / registered partnership	54.3
	Single, divorced / dissolved partnership, separated, widowed	45.7
Lifestyle factors		
BMI	Underweight (BMI < 18.5 kg/m^2)	5.9
	Normal weight (BMI ≥ 18.5 to < 25.0 kg/m^2)	65.0
	Overweight (BMI ≥ 25 to < 30.0 kg/m^2)	20.8
	Obesity (BMI ≥ 30 kg/m^2)	8.3
Smoking status	Never smokers	52.5
	Ex-smoker	20.2
	Current smokers	27.3
Alcohol ≥ 20 g/day	No	96.2
	Yes	3.8
Physical activity	≥ 150 min. per week	71.0
	< 150 min. per week	29.0
Attention to diet	Yes	76.3
	No	23.7
Health-related factors		
Diabetes	No	97.4
	Yes	2.6
Hypertension	No	81.2
	Yes	18.8
High cholesterol	No	87.1
	Yes	12.9
Chronic diseases[2]	No	69.1
	Yes	30.9
Self-perceived health	Good, very good	85.3

	Fair, poor, very poor	14.7
Psychological distress	Low	78.6
	Moderate	15.1
	High	6.3

[1] all proportions are weighted, except n
[2] ongoing diseases or health problem lasting for at least 6 months or expected to last further 6 months

Tab. 2: Associations of lifestyle and health related factors with participation in cervical cancer screening[1] in women 20-69 years; Swiss Health Survey from 2012

		unadjusted		adjusted for demographic factors[2]	
		OR	*95% CI*	*OR*	*95% CI*
Lifestyle factors					
BMI	Normal weight (BMI ≥ 18.5 to < 25.0 kg/m^2)	1		1	
	Underweight (BMI < 18.5 kg/m^2)	0.92	[0.68,1.24]	0.95	[0.70,1.30]
	Overweight (BMI ≥ 25 to < 30.0 kg/m^2)	**0.81**	**[0.69,0.95]**	0.89	[0.75,1.05]
	Obesity (BMI ≥ 30 kg/m^2)	**0.57**	**[0.46,0.72]**	**0.64**	**[0.51,0.81]**
Smoking status	Never smokers	1		1	
	Ex-smoker	**1.33**	**[1.11,1.59]**	**1.37**	**[1.14,1.65]**
	Current smokers	0.95	[0.82,1.11]	1.07	[0.91,1.25]
Alcohol ≥ 20 g/day	No	1		1	
	Yes	0.99	[0.73,1.34]	1.07	[0.78,1.47]
Physical activity	≥ 150 min. per week	1		1	
	< 150 min. per week	**0.79**	**[0.69,0.91]**	**0.85**	**[0.74,0.99]**
Attention to diet	Yes	1		1	
	No	**0.69**	**[0.59,0.80]**	**0.82**	**[0.69,0.96]**
Health-related factors					
Diabetes	No	1		1	
	Yes	0.79	[0.57,1.11]	1.00	[0.70,1.43]
Hypertension	No	1		1	
	Yes	0.85	[0.73,1.00]	0.97	[0.82,1.15]
High cholesterin	No	1		1	
	Yes	1.19	[0.99,1.43]	**1.45**	**[1.19,1.77]**
Chronic diseases[3]	No	1		1	
	Yes	**1.19**	**[1.03,1.37]**	**1.28**	**[1.11,1.48]**
Self-perceived health	Good, very good	1		1	
	Fair, poor, very poor	0.84	[0.70,1.00]	1.06	[0.88,1.28]
Psychological distress[4]	Low	1		1	
	Moderate	0.92	[0.77,1.10]	1.00	[0.83,1.20]
	High	0.78	[0.59,1.03]	0.91	[0.67,1.24]

[1] CC screening adherence defined by participation within last 3 years and weighted according the Swiss general population

[2] adjusted for age, region of Switzerland, area of residence, nationality, educational level, marital status

[3] ongoing diseases or health problem lasting for at least 6 months or expected to last further 6 months

[4] measured by the 5-item mental health index